REMARKS

Claims 2-5 and 7-13 are pending. Claims 2-4 are amended, claim 6 is canceled and new claims 12 and 13 have been added.

Support for the polyolefin chain (A1) in claims 3 and 4 can be found at page 23, lines 14-16 of the specification.

Support for the linking group X^3 of claim 4 can be found in the second full paragraph on page 138 of the present specification.

New claims 13 and 14 have been added to clarify that the polar moieties are more polar than a polyolefin. There is no explicit support for this amendment in the specification, but it is clear from each and every recitation of the term "polar" in the specification, that the term "polar" is used to define the relative polarity of the particular moiety to that of a polyolefin.

No new matter has been added by way of the above-amendment.

[I] Interview

Applicants note with appreciation that the Examiner has conducted an Interview with Applicants' representative, Garth M. Dahlen, Ph.D., Esq. (#43,575) on February 21, 2007. The Examiner was very helpful in clarifying the outstanding issues. Details of the Interview are provided below in the order in which the issues are set forth in the outstanding Office Action.

[II] Issues under 35 USC 112 (paragraph two)

Claims 2-11 stand rejected under 35 USC 112 (paragraph two) as not distinctly claiming the invention. The Examiner takes issue with the use of the term "polar". Applicants respectfully traverse the rejection.

During the February 21, 2007 Interview, the Examiner asked for an art recognized definition of the term "polar."

The term "polar polymer" in claims 1-11 in the present invention is defined as a polymer which have a polar segment, and is obtained by homopolymerizing or copolymerizing various

polar monomers. (See page 3, second paragraph in the description of the present invention). Same or similar definition sometimes appeared already in the published articles and patent such as:

1) K. Matyaszeewski et al., *Journal of Macromolecular Science Part A - Pure and Applied Chemistry*, Vol. A39, No. 9, pp. 901-913 (2002);

2) T. Matsugi et al., *Journal of Polymer Science: Part A: Polymer Chemistry*, Vol. 41 3965-3973 (2003);

3) Y. Inoue et al., *ibid.*, Vol. 42. 496-504 (2004); and

4) WO 03/078317A (Applicant; Carbon Nanotechnology, Inc).

These references were attached to the August 24, 2006 Supplemental Amendment for the Examiner's review.

Also, the website http://en.wikipedia.org/wiki/Chemical_polarity#Polarity_of_molecules (August 7, 2006) defines "Polarity of molecules" as follows:

> A compound is comprised of one or more chemical bonds between atoms. The polarity of each bond within the compound determines the *overall polarity* of the compound: how polar or non-polar it is. A polar molecule contains polar bonds - bonds which have unequal sharing of electrons between the two atoms involved in bonding. A non-polar compound contains non-polar bonds - bonds which have identical or similar sharing of electrons.
>
> However, a compound's symmetricity and net polarity must also be considered when determining the polarity of the overall molecule. Even if a compound contains only polar bonds, it may be non-polar overall as the direction of the polarities cancel each other out, giving the molecule a net polarity of zero. This occurs in boron trifluoride, which contains three identical polar bonds all cancelling each other out due to their symmetrical arrangement. Trigonal planar, tetrahedral and linear bonding arrangements often lead to symmetrical, non-polar molecules which contain polar bonds.

Accordingly, the terms "polar" and "nonpolar" are art-recognized and do not render the claims indefinite as alleged by the Examiner. As such, withdrawal of the rejection is respectfully requested.

In addition, Applicants have added new claims 12 and 13 for the Examiner's further consideration. These claims indicate that the polar polymer (side) chains are "more polar" than the polyolefin (side) chains. During the February 21 Interview, Dr. Dahlen discussed this definition of the term "polar" with the Examiner. The Examiner extensively reviewed the specification for written description support for this definition of "polar." It is true that there is no explicit support for this definition in the specification, but it is clear from each and every recitation of the term "polar" in the specification, that the term "polar" is used to define the relative polarity of the particular moiety to that of a polyolefin. The Examiner was leaning towards agreeing with Dr. Dahlen that there is sufficient implicit support for this definition, but the Examiner required further time to consider this matter and as such would not make a final determination during the Interview.

The Examiner is now invited to further consider this definition and it is hoped that the Examiner will agree that claims 12 and 13 do not include new matter.

Once the Examiner finds that there is sufficient written description support in the specification for claims 12 and 13, the Examiner is respectfully requested to consider that the MPEP sanctions such relative terminology as complying with 35 U.S.C. § 112, second paragraph. Stated another way, the fact that claim language, including terms of degree, may not be precise, does not automatically render the claim indefinite. Acceptability of the claim language depends on whether one of ordinary skill in the art would understand what is claimed, in light of the specification. See MPEP 2173.05(b).

MPEP 2173.05(b) also refers to the specific court case of *Orthokinetics, Inc. v. Safety Travel Chairs, Inc.*, 806 F.2d 1565, 1 USPQ2d 1081 (Fed. Cir. 1986) which is relevant to the present case. In this case, a claim limitation specifying that a certain part of a pediatric wheelchair be "so dimensioned as to be insertable through the space between the doorframe of an automobile and one of the seats" was held to be definite. The phrase "so dimensioned" was not

improper even though the size of the wheelchair depended upon the space between the doorframe and the seat and that space was not defined.

In new claims 12-13, the polar segments are described as being more polar than the polyolefin segments. Applicants respectfully submit that new claims 12 and 13 fully comply with the requirements of 35 USC 112, second paragraph.

[III] Issues Under 35 U.S.C. 112, first paragraph

Claims 2 and 5-11 are rejected under 35 U.S.C. 112, first paragraph. Applicants respectfully traverse the rejection.

The Examiner alleges that Applicants' amendment to claim 2 adds "new matter" to the disclosure. Specifically, the Examiner objects to the description that X^1 "*may be substituted with hydroxyl group, halogen atom or carboxyl group.*"

In response, Applicants have amended claim 2 by deleting the phrase the Examiner finds adds new matter.

Accordingly, withdrawal of the rejection is respectfully requested.

[IV] Prior Art Based Issues

The following rejections remain:

(1) Claims 2 and 5-11 stand rejected under 35 USC 102(b) as being anticipated by Matyjaszewski '473 (D1);

(2) Claims 2-4 stand rejected under 35 USC 103(a) as being unpatentable over Saito et al '414 (D2) in view of Wunsch '866 (D3) or Stephens '454 (D4);

(3) Claims 2-11 stand rejected under 35 USC 102(b) as being unpatentable over Janssen et al '542 (D5);

(4) Claims 2-11 stand rejected under 35 USC 102(e) as being unpatentable over Kennedy et al '354 (D6); and

(5) Claims 2-11 stand rejected under 35 USC 102(e)/103(a) as being unpatentable over Kennedy et al '022 (D7). [1]

[1] D1; US200210183473A [Matyjaszewski]

Applicants respectfully traverse all of the rejections.

With respect to D1, the proposed amendment to claim 2 only encompasses the following multibranched polymers:

Case #	P^2	P^3
1	A^4	A^2
2	A^4	A^3
3	A^4	A^4

D1 only discloses a polypropylene based macromonomer with methyl methacrylate. Using the inventive identifiers, the polymer of D1 is equivalent to (A^4)-X1-(A^1). This combination is no longer claimed based on the above-amendment. Furthermore, claim 2 no longer recites a polyolefin chain.

During the February 21 Interview, the Examiner indicated that the above-amendment to claim 2 distinguishes the present invention from the portion of D1 that the Examiner cites in the outstanding Office Action.

As such, there are clear patentable distinctions between the present invention and the teachings of D1.

With respect to D2, D3 and D4, Applicants believe that the above-amendment to claims 3 and 4 overcomes these rejections. Specifically, the amendment limiting (A1) to being "obtained by homopolymerizing or copolymerizing at least one of ethylene, propylene, 1-butene, 1-hexene and 1-octene" distinguishes the present invention from these references.

During the February 21 Interview, the Examiner took the position that the amendment to claims 3 and 4 are sufficient to remove the rejection with respect to these claims. With respect to claim 2, the Examiner indicated that the amendment to claim 2 would be sufficient to overcome

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D2; US4292414 [Saito]
D3; US6162866 [Wunsch]
D4; US6759454 [Stephens]
D5; EP0856542 [Janssen]
D6; US2003/0236354A [Kennedy]
D7; US2003/0204022 [Kennedy]

the rejection, but the Examiner requested that Applicants clarify for the record that the ether group (of X^1 in instant claim 2) is not a silyl ether.

In accordance with the Examiner's request, Applicants attach hereto page 221 of Grant & Hackh's Chemical Dictionary (5^{th} edition, McGraw-Hill, Inc., 1987) and pages 104-105 of Hampel et al.'s Glossary of Chemical Terms (2^{nd} edition, Van Nostrand Reinhold Company, Inc., 1982). Both of these references define an ether as having an oxygen atom bonded to two carbon atoms.

Furthermore, the Examiner's attention is directed to page 58 of the present specification which includes structures of preferred embodiments of the invention for X^1. The Examiner will note that in every instance where an ether moiety is shown, there is an oxygen bonded to two carbon atoms.

Since Applicants' disclosure is consistent with the art recognized definition of the term "ether," it is clear that the present inventors did not intend to include a silyl ether to be encompassed by the term "ether."

As such, there are clear patentable distinctions between the present invention and the teachings of D2, D3 and D4.

With respect to D5, Applicants believe that the above-amendment to claims 3 and 4 overcomes this rejection. In claim 3, the linking group X^2 has been amended to recite that it contains "less than 200 atoms in total and ~~**comprising**~~ **is selected from the group consisting of** i) at least two ether moieties, ii) at least two ester moieties or iii) at least one ether moiety and at least one ester moiety." In claim 4, the group X^3 can no longer be derived from a multifunctional low-molecular compound having an amino group. X^3 is now defined as being a linking group of less than 200 atoms consisting of a multifunctional low-molecular compound residue derived from a multifunctional low-molecular compound selected from halogenated silane, metal halide, alkyl aluminum, glycerin, pentaerythritol, D-glucitol, quercitol, inositol, trihydroxybenzene, hexahydroxybenzene, and carboxylic anhydride. As such, there are clear patentable distinctions between the present invention and the teachings of D5.

With respect to D6 and D7, Applicants believe that the above-amendments to claims 2-4 overcomes this rejection. Both D6 and D7 describe a calix[n]arene bonded to a polyisobutylene (PIB) copolymer. The Examiner will note that the claims 2 and 3 are distinct because they define the polyolefin in a manner that does not include PIB.

The Examiner has taken the position that the PIB-PAN copolymer of D6 (see 0036 and 0037 of D6) and the PIB-PDMAEMA, PIB-PAN, PIB-PMMA and PIB-PMAA copolymers of D7 (see 0070+ of D7) meet instant claim 4. The Examiner has taken the position that polymers (such as PAN) which are bonded to the PIB group render the whole copolymer a polar polymer chain as defined by (A3) of instant claim 4.

In response, Applicants have amended claim 4 so that X^3 is now defined as being a linking group of less than 200 atoms consisting of a multifunctional low-molecular compound residue derived from a multifunctional low-molecular compound selected from halogenated silane, metal halide, alkyl aluminum, glycerin, pentaerythritol, D-glucitol, quercitol, inositol, trihydroxybenzene, hexahydroxybenzene, and carboxylic anhydride. As such, there are clear patentable distinctions between the present invention and the teachings of D6 and D7.

In view of the above amendment, applicant believes the pending application is in condition for allowance.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Garth M. Dahlen, Ph.D., Esq. Reg. No. 43,575 at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§1.16 or 1.14; particularly, extension of time fees.

Dated: March 2, 2007

Respectfully submitted,

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Attachments: 1) page 221 of Grant & Hackh's Chemical Dictionary (5th edition, McGraw-Hill, Inc., 1987) and
2) pages 104-105 of Hampel et al.'s Glossary of Chemical Terms (2nd edition, Van Nostrand Reinhold Company, Inc., 1982)

GRANT & HACKH'S

CHEMICAL DICTIONARY

[*American, International, European and British Usage*]

Containing the Words Generally Used in Chemistry, and Many of the Terms Used in the Related Sciences of Physics, Medicine, Engineering, Biology, Pharmacy, Astrophysics, Agriculture, Mineralogy, etc.

Based on Recent Scientific Literature

FIFTH EDITION

Completely Revised and Edited by

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The previous edition of this book was *Hackh's Chemical Dictionary*, 4th ed., published by McGraw-Hill in 1969. It was prepared by Dr. Julius Grant from a *Chemical Dictionary* compiled by Ingo W. D. Hackh. The current, or 5th, edition of this book was prepared by Dr. Roger L. Grant, whose father prepared the 4th edition.

The editors for this book were Betty J. Sun and Susan Thomas, the designer was Naomi Auerbach, and the production supervisor was Teresa F. Leaden. It was set in Palatino by University Graphics, Inc.

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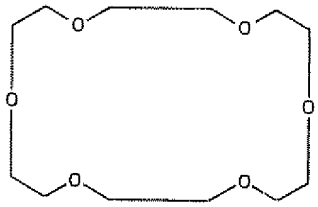
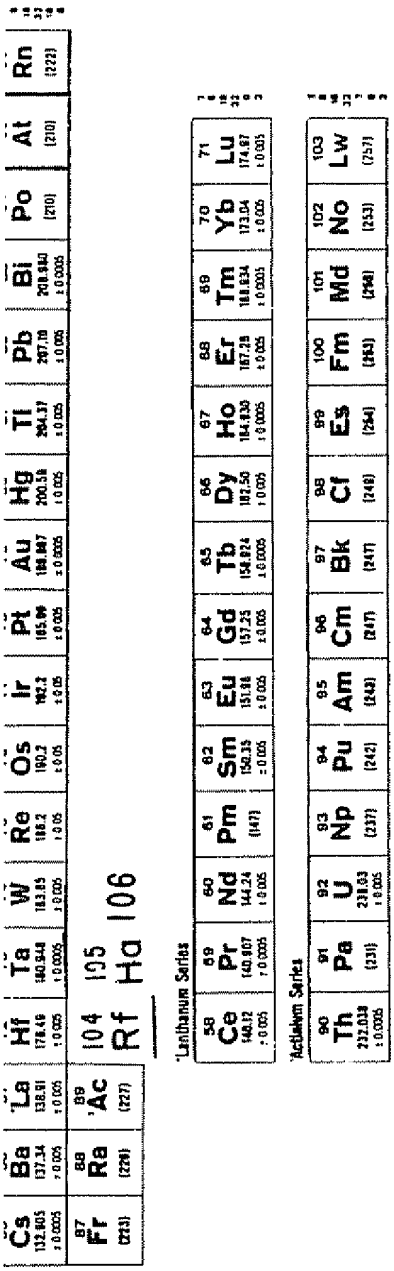
etherin Ethylin e. **theory** A theory of the constitution of organic compounds (Dumas and Boullay, 1828).
etherion A supposed element, at. wt. 0.001, expelled from substances at high temperatures and low pressures.
etheron Aetheron A supposed particle of the ether, smaller and faster than an electron; a mass of $\frac{1}{17} \times 10^9$ that of hydrogen, speed 473,000 km/s
etherophosphoric acid Ethyl phosphate
etherosulfuric acid Ethyl hydrogensulfate*.
ethers (1)* Compounds of general formula R-O-R Indicated by the name ether or by the infixes -oxy- or -oxa-. (2) The halogen derivatives of alkyl and aryl radicals, as R Cl, and the esters of inorganic or organic acids, as R NO_2, are both sometimes incorrectly called ethers **complex ~, compound ~** (1) Esters*. (2) Mixed e **crown ~** Polyethers, of a shape resembling a crown Form complexes with metal ions, as: **15-crown-5- ~** $(CH_2 \cdot CH_2 \cdot O)_5$ = 220.3 $b_2$116. **18-crown-6- ~** $(CH_2 \cdot CH_2 \cdot O)_6$ = 264.3 m.39



cyclic ~ E. in which the initial C atom in the series is linked directly to the oxide O; as, ethylene oxide, $CH_2 \cdot CH_2 \cdot O$

haloid ~ Alkyl or aryl halides **mixed ~** Compound. Alkyl or aryl ethers with 2 different radicals **simple ~** Alkyl or aryl ethers having 2 like radicals, R O R **thio ~** Alkyl or aryl sulfides in which the e oxygen is replaced by sulfur Cf *thiols*
ethide A compound of the ethyl radical and a metal; as, diethylplumbane* (lead ethide), Et_2Pb
ethidine The ethylidene* radical.
ethine Acetylene* e. **series** Alkynes*.
ethinyl The ethynyl* radical. e. **estradiol** $C_{20}H_{24}O_2$ = 296.4. Feminone, Lynoral White crystals, m 144, insoluble in water An estrogen component of many oral contraceptives. Used to treat menopausal symptoms and other conditions due to estrogen lack (USP, EP, BP).
ethiodized oil Iodized oil, Lipiodol. A sterile iodine addition product of vegetable oils, usually made by treating poppyseed oil with hydriodic acid (38–42% of organically combined iodine) A radiopaque medium (USP, BP)
ethionamide $C_8H_{10}N_2S$ = 166.2 2-Ethylthioisonicotinamide Yellow crystals, m 163, insoluble in water Antituberculous agent, used when bacteria are resistant to drugs.
ethionic acid HO SO_2 $CH_2 \cdot CH_2$ SO_2OH = 109.2 Ethylenedisulfonic acid, known only in solution Cf *isethionic acid* **amino ~** Taurine*.
ethiops mineral Black mercurous sulfide
ethisterone $C_{21}H_{28}O_2$ = 312.5. Pregneninolone, anhydrohydroxyprogesterone. Oraluton White crystals, darkening in light, m 274 (decomp.), insoluble in water; a progestational hormone (BP).
ethocaine Procaine hydrochloride
Ethocel Trademark for ethylcellulose
ethohexadiol $C_8H_{18}O_2$ = 146.2 2-Ethyl-1,3-hexanediol*. Colorless oil, soluble in water, distills 240–250; an insect repellent
etholide A tertiary lipid formed from alcohol acids by the esterification of the hydroxyl group of one with the carboxyl group of the other molecule
ethopropazine hydrochloride $C_{19}H_{24}N_2S \cdot HCl$ = 348.9 White, bitter crystals, slightly soluble in water Used for Parkinson's disease (USP, BP)
ethosuximide $C_7H_{11}O_2N$ = 141.2 2-Ethyl-2-methylsuccinimide. Zarontin White powder, m 46, soluble in water; an anticonvulsant used for petit mal epilepsy (USP, BP)
ethoxalyl* Ethoxyoxacetyl† The radical EtOOC CO–
ethoxide Ethanolate*.
ethoxy* The radical C_2H_5O–, from ethanol. e. **acetic acid** Ethylglycolic acid* e. **acetone** $MeCOCH_2OEt$ = 102.1 Colorless liquid b 128; a solvent e. **aniline** $C_8H_{11}ON$ = 137.2 Colorless liquid, d_0 1.11, b 286, sparingly soluble in water e. **butyric acid** Ethylhydroxy*butanoic acid*. e. **caffeine** $C_{10}H_{14}O_3N_4$ = 238.2 Colorless crystals, m.140 Slightly soluble in water; a narcotic. e. **carbonyl*** The radical EtOOC– e. **catechol** $C_8H_{10}O_2$ = 138.2 A homolog of guaiacol e. **oxoacetyl†** See *ethoxalyl*
ethoxyl The ethoxy* radical
Ethyl (1) (cap) Trademark for an antiknock compound to prevent or reduce knocking in internal-combustion engines Also a trademark for other products not necessarily associated with fuels or internal-combustion engines See *Ethyl gas* (2)* (not cap.) The radical C_2H_5– or Et–, from ethane *N*-e. **acetamide*** $MeCONHEt$ = 87.1 Colorless liquid, b.200; used in organic synthesis e. **acetate*** $Me \cdot COOEt$ = 88.1 Acetic ether, acetic ester, acetidin Colorless liquid, m –82, b 77, slightly soluble in water. Used as a reagent in organic synthesis, as a solvent for lacquers, in the separation of dyes, and as a flavoring in pharmacy (NF) e. **acetoacetate*** $MeCOCH_2COOEt$ = 130.1 Acetoacetic ester, diacetic ether Colorless liquid, b 181, slightly soluble in water; a solvent e. **acetylene** Butyne* e. **acid phosphate** See *e. phosphate* below. e. **acid sulfate** E. hydrogensulfate*. e. **acrylate** $C_5H_8O_2$ = 100.1 Colorless liquid, b 99 e. **alcohol** Ethanol* e. **aldehyde** Acetaldehyde*. e. **allyl** C_5H_{10} = 70.1 Colorless liquid, b.70 e. **amine*** $EtNH_2$ = 45.08. Ethamine. aminoethane. A ptomaine from putrefying yeast and wheat flour. Colorless liquid, b 17, miscible with water e. **amino*** The radical EtNH–, from ethylamine e. **aminoacetate*** NH_2CH_2COOEt = 103.1 Ethylglycine. e. **glycol** e. **aminobenzoate** Benzocaine *N*-e. **aminobenzoic acid** $EtNH \cdot C_6H_4 \cdot COOH$ = 165.2 Colorless prisms, m 112, slightly soluble in water e. **aniline** See *ethylaniline* under *aniline* e. **anthracene** $C_{16}H_{14}$ = 206.3 Colorless scales, m 60, insoluble in water e. **dihydro ~** $C_{16}H_{16}$ = 208.3 Colorless oil, m.320, insoluble in water e. **arsine dichloride*** $EtAsCl_2$ = 174.9. Dick A liquid, d 1.66, b 155; a vesicant and lung irritant, formerly a war gas e. **benzene** See *ethylbenzene* under *benzene* e. **benzoate*** $PhCOOEt$ = 150.2. Colorless liquid, b 213, slightly soluble in water e. **benzoic acid** See *ethylbenzoic acid* under *benzoic acid*. e. **benzoylacetate** $PhCOCH_2COOEt$ = 192.2 Benzoyl acetic ester Colorless liquid, b 267, insoluble in water e. **benzylaniline** Ph N Et (CH_2Ph) = 211.3 Ethylbenzylphenylamine. b_{710mm}285 e. **borate** A salt of ethanol and boric acid e. **orthoborate** $B(OEt)_3$ = 146.0 Boron triethoxide, triethylic borate Colorless, flammable liquid e. **metaborate** $(EtO)_2(BO)_2$ = 143.7 Colorless, heavy liquid e. **pyroborate** EtB_3O_5 = 141.5. E. borate. A colorless, gummy mass e. **boric acid** $EtB(OH)_2$ = 73.9 White crystals, sublime 40, soluble in



Periodic Table of the Elements

GLOSSARY OF CHEMICAL TERMS

SECOND EDITION

Clifford A. Hampel
Consulting Chemical Engineer

AND

Gessner G. Hawley
Editor, CONDENSED CHEMICAL DICTIONARY

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PREFACE TO F

Dr. Samuel Johnson, who compiled the first *Dict*
people need less to be informed than to be remind
comfort and hope to all who have undertaken to pr
It applies with particular force to the authors of thi
by two additional definitions

The first is that of the word *definition* itself. Prin
to the meaning of terms and expressions. In chemi
than done, for there is no predetermined way in w
quite satisfactory to one person may be only the b
to another. The inherently tricky nature of words is
different meanings even within the framework of a s
carefully without obscuring their underlying relatio

A useful definition should certainly tell *what* a
appropriate example or two; but to explain *why* it
the ultimate reason seeming to retreat in an endles
limits not only to the terms themselves but also to t
definitions are intended. Since definitions that a bo
would be of little value to a professional chemist, i
of knowledge and experience of his expected audie

The second definition concerns the word *glossar*
field of knowledge, as opposed to *dictionary*—a r
presenting intensive coverage of the terminology of

This Glossary is intended for those who have h
source of review information. Superficial though it
chemical definitions that serves this need. The sever
and highly useful volumes which have established
selves in respect to emphasis and treatment and
engineers, and industrial technologists. They are of
those without considerable background in chemistr

The emphasis in this Glossary has been placed c

(a) All major chemical classifications, e g . alc
gum, resin, wax, etc.
(b) All important functional terms, e g , cata
tioxidant, etc
(c) Basic phenomena and processes, e g , ox
tation, distillation, filtration, vapor pressu
(d) All the chemical elements, both natural a
(e) The most important compounds. e g., amr
acid, etc. (the number of these has been p
(f) General terms, e g , acid, base, indicator
(g) Biographies of outstanding past contribut

used in lasers, magnetic alloys, and similar
ialized devices It forms compounds with
halogens and also appears as the nitrate,
ate, phosphate, carbonate, and acetate *See*
yttrium; terbium

erol. A member of the biochemically ac-
sterol family of compounds and a precursor
itamin D_2, or calciferol, to which it is con-
ed by exposure to ultraviolet radiation It is
known as provitamin D_2. Both the com-
id and its name are derived from the fungus
t; it also can be formed from sugars by the
n of yeast. Its primary function in the body
catalyze the deposition of calcium in the
s and teeth (as suggested by the name cal-
ol) It occurs in yeast and fish-liver oils
also sterol; vitamin

neyer flask. A useful type of laboratory
sware; it is an open container whose di-
sions are, for example, about 8 inches tall,
a relatively narrow neck section about 1½
es in diameter and 2 inches long, below
h the contour becomes cone-shaped The
m is flat It is used for numerous experi-
ts involving liquids, especially titrations and
ictive testing It was named after its inven-

ocyte. The most vital component of mam-
an blood, chiefly composed of the protein-
complex called hemoglobin and commonly
wn as the red cell of the blood Erythrocytes
be removed from blood by centrifugation,
ve plasma. *See also* blood

ymbol for the element einsteinium, the name
g assigned in honor of Albert Einstein, an
rican scientist (German-born) (1879-1955),
el Prize 1921

al. (1) An amino acid, vitamin, or fatty
that is not synthesized by the animal or-
sm but must be obtained externally, that is,
ngestion of plant products of one type or
her. *See also* amino acid

) An oil distilled from the flowers, leaves,
ems of certain plants; in a figurative sense
presents the "essence" of the plant and does
mply necessity or need *See also* essential
perfume

al oil. A nonfatty oil with a strong, usually
sant, odor and taste, obtained from flowers
other parts of plants by solvent extraction
team distillation Terpenes are the chief
ponents of many essential oils; others are
mixtures of aldehydes, acids, alcohols, and the like, e g., benzaldehyde and hydrocyanic acid occur in oil of bitter almond. Essential oils are subject to evaporation, in contrast to fixed vegetable oils, which are not They are obtained from a wide variety of plant life, some having such exotic names as oil bois de rose, neroli oil, ylang-ylang oil, geraniol, rose otto, patchouli oil, and citrus peel oils They are used in perfumes, odorants, and food flavorings An exception is turpentine oil, used chiefly as a solvent and paint thinner. The term "essential" refers to the distilled "essence" of a material, not to its importance Though they are products of vegetation, essential oils are not classified as vegetable oils. *See also* vegetable oil; edible oil

ester. A compound that can be regarded as formed by the replacement of the acidic hydrogen of an inorganic or organic acid by an aliphatic, aromatic, or heterocyclic radical The term usually has the connotation of a substance prepared from a carboxylic acid and an alcohol or phenolic hydroxy compound. The general formula for an ester is RCOOR. While the reaction ROH + RCOOH→RCOOR + H_2O appears analogous to the salt-forming acid-base neutralization of inorganic chemistry, its mechanism is different By used of a tagged oxygen isotope, it has been shown that the oxygen of the coproduct water comes from the −OH group of the carboxylic acid and not from the alcohol. The reaction is of the condensation type and often requires a catalyst

Esters are named in terms of the acids and alcohols from which they are formed. Acetic acid yields acetates; fatty acids give glycerides; butyric acid forms butyrates; and carbonic acid gives organic carbonates, such as dimethyl carbonate Esters are of widespread occurrence and have a broad range of applications. Important types are cellulose esters (acetate, butyrate, propionate) for fibers and plastics; phthalic acid esters for plasticizers; vegetable and animal waxes, which are alkyl esters of monocarboxylic acids; and polyester and alkyl resins, from dicarboxylic acids and dihydric alcohols. Ester formation (esterification) is an important and frequently used reaction in synthetic organic chemistry *See also* polyester

ester gum. An artificial product made by reacting rosin with glycerol or other polyhydric alcohol It is actually a resin rather than a gum It is used as an ingredient of industrial cellulosic lacquers and in special paint formulations It is soluble in most organic solvents

esterification. *See* ester; acetate

estrogen. Collective term for naturally occurring steroid compounds formed in the ovary; they are also made synthetically Estrogens have hormonal activity and are essential for normal female sexual development Among the more important are estrone and estradiol. They can be obtained from the urine of pregnant animals and can be synthesized from other sterols. Estrogens have applications in the oral contraceptive field and for specialized medical purposes. *See also* antifertility agent

e.s.u. Abbreviation for elecrostatic unit

Et Symbol often used in chemical formulas for the univalent ethyl group, C_2H_5.

ethanal. *See* acetaldehyde

ethane. A saturated aliphatic hydrocarbon gas, one of the seven basic petroleum-derived gases. It is the second member of the homologous series (paraffins) which starts with methane; its formula is C_2H_6. Like other gases of its type, it is extremely flammable. It is used as a source of ethylene and in general organic synthesis, as a fuel (in liquefied form), and as a refrigerant It readily combines with chlorine to give, e g , ethyl chloride It is not particularly toxic. *See also* ethylene; natural gas.

ethanol. *See* ethyl alcohol

ethanolamine. A syrupy yellowish liquid, b p 172°C (342°F), which has a strongly basic reaction, and thus is widely used to remove hydrogen sulfide and other acidic gases from synthesis gas. Its formula is $HO(CH_2)_2NH_2$ It is irritant to the eyes and skin and is considered toxic when inhaled Ethanolamine and its derivatives di- and triethanolamine result from reacting ammonia with ethylene oxide Other industrial applications are in the scouring of wool fibers, in dry-cleaning compounds, and for vulcanization of rubber

ethene. *See* ethylene

ether. A class of organic compounds characterized by the presence of an oxygen atom covalently bonded between two carbon atoms If the organic groups containing carbon are represented by the letter R, the generalized formula of an ether is ROR Ethers are derived either by removing water from alcohols (dehydration) or by hydration of olefins by means of a catalyst.

Most common ethers are liquids, and some are extremely flammable. The most prominent one is diethyl ether, $(C_2H_5)_2O$, b.p. 34.6°C (94°F), a valuable anesthetic first used in surgery in 1846; it is also a useful solvent and extraction medium. The ethers of ethylene glycol form a well-known group of useful solvents and plasticizers. There are a few solid ethers of cellulose. The term "petroleum ether" for petroleum-derived naphtha is a misnomer.

ethical drug. A drug obtainable on prescription, not offered for open sale.

ethyl. The univalent group, CH_3CH_2—, the second member of the homologous series of paraffinic hydrocarbon (alkyl) radicals; it is derived by dropping one hydrogen atom from ethane, CH_3CH_3, and often appears in formulas as C_2H_5—. When a second hydrogen atom is dropped from ethane, the divalent ethylene group is formed, —CH_2CH_2— The corresponding olefin, $H_2C{=}CH_2$, is also called ethylene, and the two meanings of ethylene are sometimes confused in naming compounds. Like the methyl group, the ethyl group is present in thousands of organic compounds. *See also* ethylene; methyl.

ethyl acetate. A light, mobile liquid, b.p. 77°C (171°F), resulting from the esterification of ethyl alcohol with acetic acid, catalyzed by sulfuric acid; its formula is $CH_3COOC_2H_5$. It is very flammable and a possible explosion hazard. It is used in the manufacture of smokeless powder and is an excellent solvent in nitrocellulose lacquers; with alcohol, it will also dissolve cellulose acetate. It also has application in the manufacture of pharmaceutical products and as an organic intermediate. *See also* acetate.

ethyl alcohol. A liquid monohydric primary alcohol, b.p. 78.5°C (173°F), having the formula C_2H_5OH (or CH_3CH_2OH); it is also called ethanol, grain alcohol, or simply "alcohol." It is the most important organic solvent in use today; well over two billion pounds is manufactured annually. Beverage grades are made by fermentation of the sugars in fruits, molasses, and grains. It is classed as a depressant and has a low order of toxicity. Most industrial alcohol is made synthetically by catalytic cracking of hydrocarbons or by the Oxo process. It is used in numerous end-products (detergents, cosmetics, solvents, cleaning preparations) and as an intermediate in the manufacture of organic chemicals. Recent production from agricultural wastes has made possible its expanding use as a motor fuel additive (gasohol); it may eventually replace gasoline, as is already the tendency in Brazil. Denatured grades contain certain noxious or toxic additives (often methyl alcohol) to prevent internal use. Ethyl alcohol is flammable and should be protected from ignition sources. *See also* denaturant; Oxo process; fermentation; gasohol.

ethylamine. A flammable and toxic liquid, b.p. 16.6°C (62°F), having the formula $CH_3CH_2NH_2$ and made by reacting ammonia with ethyl chloride; also called aminoethane. Though it has solvent properties, its chief uses in the chemical industry are as an intermediate for the synthesis of dyes and and related organic compounds. It should be handled with caution. *See also* amine.

ethylbenzene. *See* aluminum chloride; Friedel-Crafts reaction.

ethycellulose. A thermoplastic product, insoluble in water; it is made by replacing about half of the hydroxyl groups of cellulose with ethoxy groups (OC_2H_5), derived from ethyl alcohol or similar compounds. It is thus a cellulose ether. Its major uses are in coatings for a broad range of industrial products (paper, textiles, wire and cable), and as an adhesive and binding additive in printing inks, pigments, and similar materials.

ethyl chloride. A saturated chlorinated hydrocarbon, C_2H_5Cl, b.p. 12°C (54°F), gaseous at room temperature but manufactured and transported in compressed form as a liquid. Like other compounds of this class, it is quite poisonous and extremely flammable and should be handled with caution and protected from exposure to static sparks or other flame source, which may cause explosion. It has solvent properties for organic materials and for certain elements such as sulfur and phosphorus; it is used in making tetraethyllead and as an insecticide base. *See also* chlorinated hydrocarbon.

ethylene. (1) An unsaturated aliphatic hydrocarbon (olefin), ethylene is obtained by thermal cracking of petroleum gases (butane, ethane, etc.), a process known as pyrolysis. Ethylene is one of the most prolific sources of synthetic organic chemicals and plastics. Its formula, $H_2C{=}CH_2$, is a reactive structure of far-reaching importance which occurs in many products besides ethylene, e.g., butadiene and isoprene. Ethylene (also called ethene) is a flammable and explosive gas, b.p. −103.9°C (-155°F), from which a number of basic petrochemicals are derived by catalytic processes, for example, ethyl alcoho ethylene oxide, ethylene dichloride, and ethy ene chlorohydrin. These in turn are intermed ates for a wide range of synthetic organics, typic of which is the ethylene glycol family. Ethyle is also the parent substance of many elastomer and plastic products, e.g., polystyrene, pol ethylene, ethylene-propylene rubbers, and pol ester resins. Many of these can be cross-link to form thermosetting plastics.

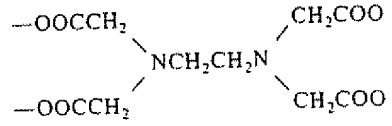
(2) The divalent group —CH_2CH_2—, form when a hydrogen attached to each carbon at of ethane, CH_3CH_3, is replaced by another e ment or group, as in ethylene dichloric $ClCH_2CH_2Cl$. *See also* polyethylene; ethyle glycol; ethyl.

ethylene bromide. *See* bromine.

ethylene chlorohydrin. Made by reacting e ylene with hypochlorous acid, this compoun an extremely toxic liquid which is readily sorbed by the skin, sometimes with lethal effe Its formula is $Cl(CH_2)_2OH$, b.p. 128.8°C (262° it may be regarded as an alcohol in chemi constitution. It is used as a solvent for vari cellulosic plastics and in the synthesis of ot organic compounds including ethylene gly and ethylene oxide. Great caution should exercised in handling this material.

ethylenediamine. *See* ligand.

ethylenediaminetetraacetic acid. Often ferred to by its abbreviation EDTA, this c pound is one of the best-known and most fective complexing agents, coordinating stro with metal ions to form chelates. It is comm cially obtainable in the form of various (edetates) as, for example, tetrasodium ED It forms stable compounds with metal ions thus has the effect of deactivating them. I ordinates through no less than six linkages— nitrogen atoms and four carboxyl groups:



EDTA forms soluble complexes with io calcium, magnesium, iron, etc., and is us a water-softening agent and detergent; it als applications in electroplating, preparatior